USB Type C & Power Delivery

All in one: Type C connector

One for all: PD adapter/charger
Mu One 45W PD: World Thinnest Adapter

- 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/2.25A
- 14 mm profile
- CE, UL, etc.
- Available now on www.amazon.com

Images courtesy Made-in-Mind
RAVPower 45W: Same Platform

45W Power Delivery
2.5X Faster

Macbook 12"
2.0 hrs

iPhone XS Max
1.8 hrs

• Available now on www.amazon.com

Images courtesy RAVPower
AUKEY 24W, 27W, 30W

AUKEY | GaNFast™

Up to 3x faster charging with half the size and weight for unparalleled mobility.

27W USB-C PD

27W USB-C PD

2 x 12W USB-A

30W USB-C PD

• Available now on www.amazon.com

Images courtesy AUKEY
A. Select the right semiconductor devices
B. Select the right topology, frequency and control
C. Select the right magnetics and design properly
World First GaN Power IC

**Single GaN IC**
- Monolithic integration, 650V
  - GaN FET + GaN Driver + GaN Logic

**Half-bridge GaN IC**
- Monolithic integration, 650V
  - 2x GaN FETs
  - 2x GaN drivers
  - GaN Logic (level-shift, bootstrap, shoot-through)

*Clean HF waveform*
Active Clamp Flyback with Soft-Switching

Commercial IC Available!!
GaN vs. Si in ACF
2%-3% Higher Efficiency with Low $C_{OSS}$, $Q_G$, $Q_{rr}$, $E_{off}$

<table>
<thead>
<tr>
<th>IPA60R299CP</th>
<th>NV6260 (per FET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Rating (V)</td>
<td>650</td>
</tr>
<tr>
<td>$R_{DS(ON)}$</td>
<td>270</td>
</tr>
<tr>
<td>$C_o (tr)$ (pF)</td>
<td>120</td>
</tr>
<tr>
<td>$Q_g$ (nC)</td>
<td>22</td>
</tr>
<tr>
<td>$Q_{rr}$ (nC)</td>
<td>3900</td>
</tr>
</tbody>
</table>

Courtesy of Texas Instruments (ACF w/ pri resonance)

Magnetic: Bulky / Expensive → Small / Cheap

Vol (mm³)

12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
100

~ EQ25

Innergie
(200kHz)

~ EQ25

Navitas
(400kHz)

ER25

ER23

Chrome book
(65kHz)

RM10

65kHz → 200kHz
2.5x size reduction

200kHz → 400kHz
1.5x size reduction

400kHz → 1MHz
1.5x size reduction

Freq (kHz)
Planar Magnetics ➔ Manufacturability

- SR on sec winding, minimized $L_k$ & $R_{ac}$
- Shielding integrated as pri winding
- Safety rule compliance
45 W in 11 mm = HF Planar ACF

- Planar Transformer
- NV611x Power ICs
- Type-C Receptacle
- Bulk Caps
- AC Bridge
- ACF IC UCC28780
- EMI Filter
- PD IC
- SR FET

- Size : 29 cc (41 cc with case)
- Density : 1.7 W/cci (27 W/in^3), 1.1 W/cci (18 W/in^3) cased

Proprietary; Authorized Use with Navitas License
Cool Operation

90 V$_{AC}$, 45 W, 25 °C, uncased, no airflow, no thermal compound / heatsinking
High Efficiency

Full Load Efficiency

4-Point Average Efficiency

115V, 90V, 230V, CoC Tier 2

Efficiency vs. Voltage (Vo=5V, 9V, 15V, 20V)
Quiet EMI (Conducted, Radiated)

CE: 115Vac 20V/2.25A
CE: 230Vac 20V/2.25A

RE: 230Vac 20V/2.25A
Horizontal
RE: 230Vac 20V/2.25A
Vertical
• Thanks to Matt Judkins, CEO of Made-in-Mind (Mu)
• Available via [www.kickstarter.com](http://www.kickstarter.com) now, and via [www.amazon.com](http://www.amazon.com) and airport stores in April

Images courtesy Made-in-Mind
The New World of Fast Charging

Information available on www.navitassemi.com
Let’s go GaNFast™